PROJECT NO.: SM 072893-G

JUNE 28, 2010

SUPPLEMENTAL GEOTECHNICAL INVESTIGATION
PLAINS ROAD WEST STORM SEWER OUTFALL RELOCATION AT HIGH LEVEL BRIDGE
BURLINGTON, ONTARIO
CITY OF BURLINGTON FILE NO.: 570.02-366

PREPARED FOR:

AMEC EARTH AND ENVIRONMENTAL LIMITED

Soil-Mat

BY

SOIL-MAT ENGINEERS & CONSULTANTS LTD.
130 LANCING DRIVE
HAMILTON, ONTARIO
L8W 3A1

Soil-Mat

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PROJECT NO.: SM 072893-G June 28, 2010

AMEC Earth and Environmental Limited
3215 South Service Road
P.O. Box 220
Burlington, Ontario
L7R 3Y2

Attention: Mr. Paul Smeltzer, P. Eng.

SUPPLEMENTAL GEOTECHNICAL INVESTIGATION
PLAINS ROAD WEST STORM SEWER OUTFALL RELOCATION AT HIGH LEVEL BRIDGE
BURLINGTON, ONTARIO
CITY OF BURLINGTON FILE NO.: 570.02-366

Dear Mr. Smeltzer,

Further to your authorisation we have completed the fieldwork and laboratory testing, and report preparation, in connection with the above noted project. Our comments and recommendations, based on our findings at the three borehole locations, are presented in the following paragraphs. This supplemental report must be read on conjunction with our initial geotechnical investigation report dated June 28, 2008.

1. INTRODUCTION

We understand that the project will consist of the replacement of the existing storm sewer pipeline, along a portion of Plains Road West in Burlington, Ontario. This pipeline and manhole structures has experienced significant collapse/movements primarily due to erosion of the primarily granular supporting soils. The storm sewer outfall reconstruction project is associated with the sewer system servicing Spring Gardens Road, Botanical Drive, Plains Road West, and the future connection of Grandview Avenue, Plainsview Avenue and Brookview Avenue. The proposed realignment scheme will incorporate a stormceptor and a series of seven manhole structures to facilitate the approximate 18-metre change in invert levels [existing manhole to outfall structure] to allow discharge to Grindstone Creek. The proposed realignment will extend about 24 metres from the existing manhole on the south side of Plains Road West, then to the north side of the roadway and bridge structure for about 50 metres and then to the south side to allow for connection to the outfall structure.

This report is based on the above summarised project description, and on the assumption that the design and construction will be performed in accordance with the applicable codes and standards. Any significant deviations from the proposed project

design may void the recommendations given in this report. If significant changes are made to the proposed design, then this office must be consulted to review the new design with respect to the results of this investigation. The information contained in this report does not reflect upon the environmental aspects of the site and therefore have not been addressed in this document.

2. PROCEDURE

A total of three [3] sampled boreholes were advanced at locations as access permitted and illustrated as BH-101, BH-102 and BH-103 on the enclosed Drawing No. 1A, Borehole Location Plan. The borings were advanced using hollow stem continuous flight auger equipment under the supervision of SOIL-MAT ENGINEERS to depths of between about 12.7 and 15.7 metres below the existing ground surface on March 22, 2010.

Representative samples of the subsoils were recovered from the borings at selected depth intervals using split barrel sampling equipment driven in accordance with the requirements of the ASTM test specification D1586, Standard Penetration Resistance Testing. After undergoing a general field examination, the soil samples were preserved and transported to the Soil-Mat laboratory for visual, tactile, and olfactory classifications. Routine moisture content tests were performed on all soil samples.

All surveying associated with locating the boreholes in the field and determining their ground surface elevations was carried out by representatives of Soil-Mat Engineers. The ground surface elevations were referenced to two site specific geodetic benchmarks acquired from AMEC Earth & Environmental [formerly Philips Engineering Ltd.]. Benchmark No. 1 is described as the manhole just east of the Plains Road West bridge span, at Elevation 100.61 metres. Benchmark No. 2 is describe as the southwest corner of the concrete of the east abutment at Elevation 95.43 metres.

The results of the subsurface investigation are detailed in Borehole Log Nos. 101, 102 and 103, which can be found following the text of this report. It is noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design and therefore should not be construed as the exact planes of geological change.

3. SITE DESCRIPTION AND SUBSURFACE CONDITIONS

The subject site is located on the south and north sides of Plains Road West in Burlington, Ontario at the high level bridge structure over the Grindstone Creek. The property grade slopes to the west at an overall slope of about 3 Horizontal to 1 Vertical, with some steeper profile sections. The project area is currently primarily covered with

high grasses, scrub vegetation and some mature trees. There were a number of 'worn' pathways found along the proposed sewer alignment, as well as erosional features.

The subsurface conditions encountered at the borehole locations are summarised as follows:

3.1 Topsoil

A surface veneer of topsoil approximately 150 millimetres in thickness is present at the borehole locations. It is noted that the depth of topsoil may vary across the site and from the borehole locations. It is also noted that the term 'topsoil' has been interpreted in this report from a geotechnical-engineering point of view. If it is to be used for landscaping purposes, its suitability should be confirmed by tests on representative samples for organic and nutrient content and therefore its ability to support plant growth.

3.2 Clayey Silt and Clayey Silt Fill

A native clayey silt was found to underlie the topsoil in Borehole No. 101. The clayey silt was found to be brown to reddish brown in colour and to contain a trace to some gravel and sand, with a trace of shale fragments and have a 'till-like' structure. The clayey silt was found to be very stiff to stiff in consistency. The clayey silt extended to a depth of about 4.0 metres in Borehole No. 101. The clayey silt was found to underlie a sand deposit in Borehole No. 102 at a depth of about 3 metres. The reddish brown clayey silt was found to contain a trace of fine gravel and sand and was stiff in consistency.

A clayey silt fill was found to underlie the topsoil material in Borehole No. 103. The clayey silt fill was found to be brown in colour with some organic staining and to contain some fine gravel and cobbles and a trace of rootlets and wood pieces. The clayey silt fill was found to be in a compact state and extend to a depth of about 4 metres below grade.

3.3 Fine Sandy Silt and Sand

A native fine sandy silt was proven at a depth of about 4 metres below grade in Borehole No. 101. The fine sandy silt was found to contain a trace of clay and gravel, together with some tree rootlets and reddish brown clayey silt seams in the lower level. The fine sandy silt was found to be in a loose to compact state and extend to a depth of about 8.5 metres below grade.

A compact to dense sand was found to underlie the fine sandy silt in Borehole No. 101, the clayey silt in Borehole No. 102 and the clayey silt fill in Borehole No. 103. A loose sand deposit was found beneath the topsoil in Borehole No. 102 to a depth of about 3 metres. The generally fine grained sand was found to contain a trace of silt and various

percentages of gravel. The sand was found to become 'wet' at the interface of the underlying silty clay material.

Although not encountered in the borings, boulders and naturally 'cemented' seams/layers are typically found in this deposit and should be expected by the contractor during excavation operations.

3.4 Silty Clay

A silty clay was proven on Borehole Nos. 101, 102 and 103 to underlie the sand at depths of between 8.5 and 14.5 metres below grade. The silty clay was found to be brown to grey in colour and very stiff in consistency. The silty clay was found to contain a trace of shale fragments in the upper level of Borehole No. 103 and clayey silt seams in Borehole No. 102. The silty clay was proven to termination of the borings at depths of between about 12.7 and 15.7 metres below grade.

3.5 Groundwater Observations

No free groundwater was observed in the borings and all three boreholes were 'dry' on completion. The groundwater level must be expected to be slightly 'higher' than that of the existing creek. Although not encountered in the boreholes perched groundwater must be expected in the more permeable granular deposits overlying the low permeability cohesive silty clay [aquitard].

4. DISCUSSIONS

We understand that the proposed 900 millimetre diameter concrete storm sewer pipe will be installed using open trench and backfill techniques, with excavations extending to about 5 metres below the present grades. The sides of excavations through the 'granular' sand and silt soils and the clayey silt fill material should remain stable, for the short construction period, at 45 degrees to the horizontal. The side slopes in the native clayey silt are expected to remain stable for the construction period at slopes of 60 degrees to the horizontal or steeper. Nevertheless, we note that all excavations must comply with the current Occupational Health and Safety Act and Regulations for Construction Projects. Excavation slopes steeper than those required in the Safety Act must be supported or a trench box must be provided, and a senior geotechnical engineer from this office should observe the work.

The majority of the excavated material will consist of the native clayey silt, sand and fine sandy silt and clayey silt fill material. These excavated materials are considered to be suitable for use as storm sewer trench backfill provided the moisture content can be controlled within 2 or 3 per cent of the standard Proctor optimum value. Some moisture content conditioning of the excavated materials will be required, depending upon the

weather conditions experienced at the time of construction, to achieve good compaction densities and minimise long-term settlements. At present, the soils are considered to be generally near their optimum moisture contents, with the exception of the upper level of the clayey silt fill which is slightly 'wet'. Regardless, all fill material should have a placement moisture content within 3 percent of its optimum moisture content. Any imported fill required in service trenches or to raise the subgrade elevation should have its moisture contents within 3 per cent of its optimum moisture content and meet the necessary environmental guidelines. Dusting could become a problem if construction is undertaken in the 'dry' summer months.

The fine grained granular soils and clayey silt/silty clay materials are sensitive to moisture absorption and will become practically impossible to compact using conventional compaction equipment if they become wet during extended periods of precipitation. The excavated materials should therefore be left exposed to the elements for a minimum period of time before being used as backfill so that they will not absorb an excessive amount of precipitation. After a period of heavy precipitation, any near-surface softened material should be allowed to dry or be removed from the fill surface and discarded.

The backfill material within the service trenches should be specified at 95 percent of its standard Proctor density. Where the trench is within Plains Road West, we would recommend that an imported well graded granular material be used and be compacted to 100 percent its standard Proctor density.

The base of excavations in the competent granular soils and clayey silt/silty clay soils should remain firm and stable. It is expected that standard pipe bedding, as typically specified by the City of Burlington will suffice for any service pipes. The bedding material should be well compacted, with special attention paid to compaction under the pipe haunches. The use of additional ballast stone for localised base stabilisation purposes might be required depending on the presence of 'wet' seams, weather conditions, etc.

It is expected that the existing pavement structure for the Plains Road West crossing will be saw cut along the excavation edges. In this regard, the contractor should exercise care along the saw cut to prevent undermining of the asphalt and future cracking. In the event that the asphalt surface becomes undermined, it will be necessary to extend the width of the saw cut portion beyond the undermined portion prior to reinstatement of the pavement.

It is anticipated that the pavement structure will be reinstated to 'match' the existing pavement structure. The granular sub-base and base courses and asphaltic concrete

layers should be compacted to OPSS or the City of Burlington requirements. A program of in-place density testing must be carried out to monitor that compaction requirements are being met.

Our comments and recommendations pertaining to the construction of the concrete headwall structure were presented in the initial geotechnical investigation report.

It is imperative that a soils engineer be retained from this office to provide geotechnical engineering services during the excavation and foundation construction phases of the project. This is to observe compliance with the design concepts and recommendations of this report and to allow changes to be made in the event that subsurface conditions differ from the conditions identified at the Borehole locations.

5. GENERAL COMMENTS

The comments provided in this document are intended only for the guidance of the design team. The subsoil descriptions and borehole information are intended to describe conditions at the borehole locations. Contractors tendering or undertaking this project should carry out due diligence in order to verify the results of this investigation and to determine how the subsurface conditions will effect their operations.

We trust that this supplemental geotechnical report is sufficient for your present requirements. Should you require any additional information or clarification as to the contents of this document, then please do not hesitate to contact the undersigned.

Yours very truly,
SOIL-MAT ENGINEERS & CONSULTANTS LTD.

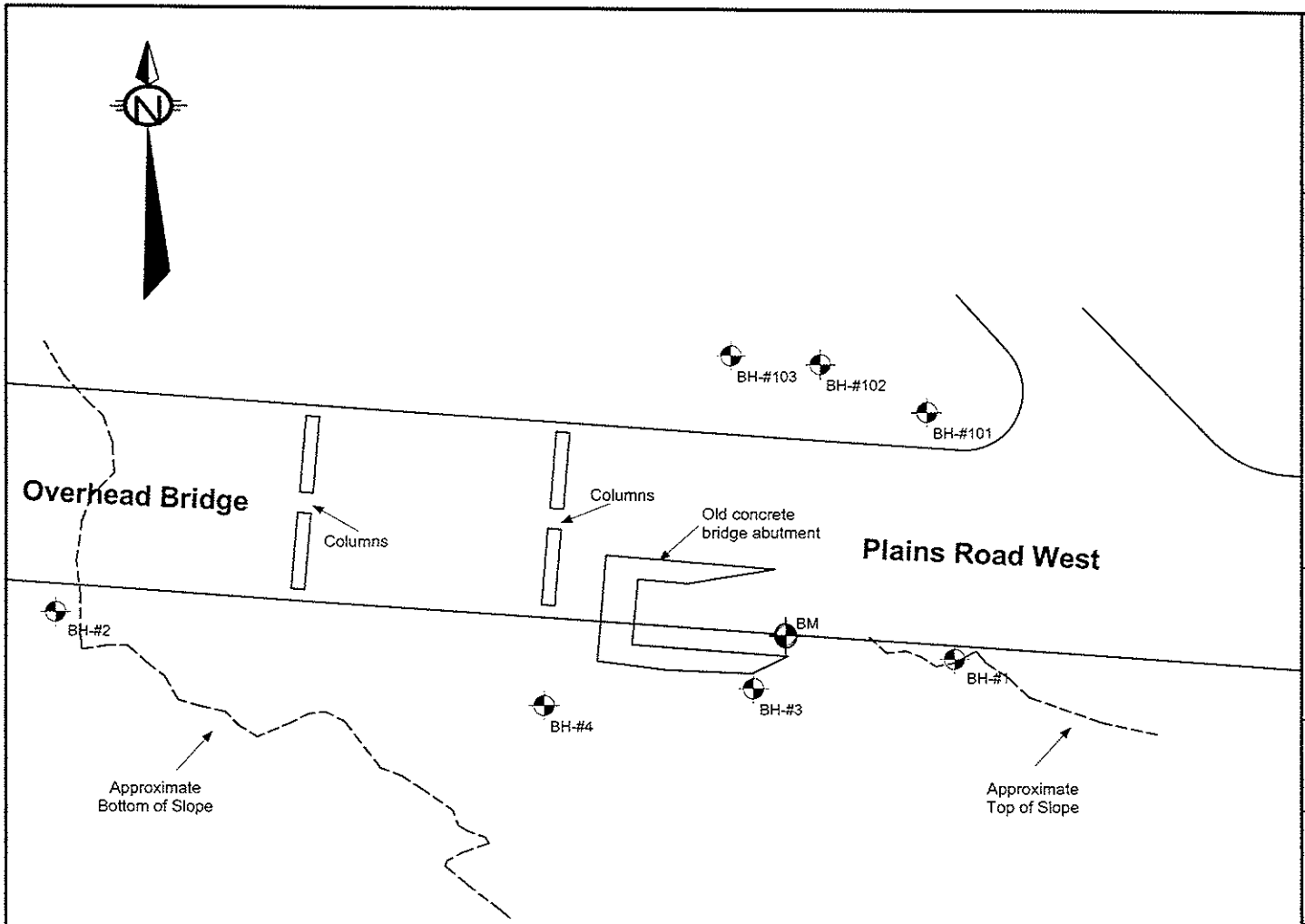
John Monkman, P. Eng.
Project Engineer

Ian Shaw, P. Eng.
Review Engineer

LICENSED PROFESSIONAL ENGINEER
J. D. MONKMAN
PROVINCE OF ONTARIO

Enclosures: Drawing No. 1, Plan Showing Borehole Locations
Borehole Log Nos. 101, 102 and 103, inclusive

Distribution: AMEC Earth and Environmental Limited [3]



LEGEND

BH-# Borehole

BM Geodetic Benchmark
Catch Basin grid, Elevation of 100.77 metres.

NOTES:

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. report number SM 072893-G
2. Soil samples will be discarded after 3 months unless directed otherwise by client.
3. Topsoil depths may vary across site and from depths at borehole locations.
4. Borehole locations are approximate.

Soil-Mat
Engineers & Consultants Ltd.

CLIENT

Philips Engineering

PROJECT TITLE

Geotechnical Investigation
Storm Sewer Outfall Relocation
Burlington, Ontario

DRAWING TITLE

Borehole Location Plan

PROJECT No.	SM 072893-G
SCALE	N.T.S.
DATE	April 2010
CHECKED	JM
DRAWN	DH
FILENAME	072893 Borehole Location Plan - 100.kcw

DRAWING No. 1

Project No: SM 072893-G

Project: Storm Sewer Outfall Relocation

Client: Phillips Engineering Ltd.

Location: Plains Road West, Burlington

Log of Borehole No. 101

Borehole Location: See Drawing No. 1

Project Manager: John Monkman, P.Eng.

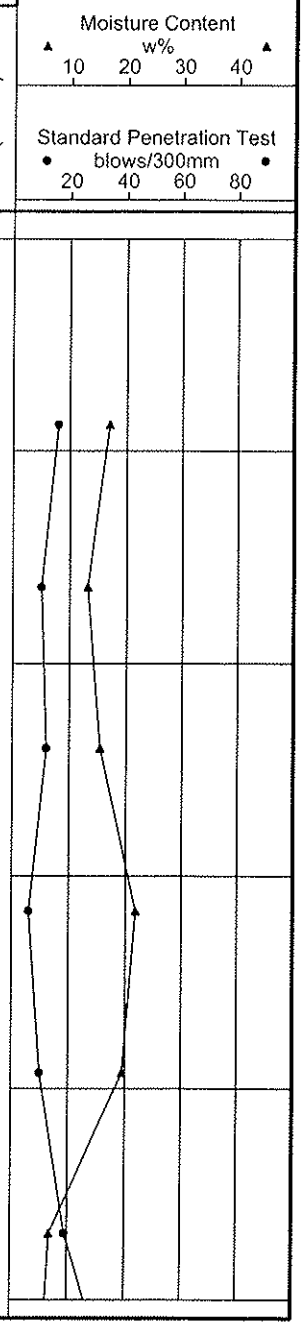
Soil-Mat

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Elevation [m]	Description	Well Data
0	0	100.42	Ground Surface	
			Topsoil Approximately 150 millimetres over,	
			Clayey Silt Brown to reddish brown, trace to some fine gravel, sand and shale fragments, 'till like' structure, shale fragments, trace of organics in the upper level, very stiff to stiff	
		96.42	***Fine Sandy Silt*** Reddish brown trace of clay and gravel, some rootlets, reddish brown clayey silt seams in lower level, loose to compact	
		91.92	***Sand*** Brown, 'fine' grained, trace to some silt and trace fine gravel, brown clayey silt seam at 12.5m depth, compact to dense	

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2), Qu	U.Wt.(kN/m3)
SS	1	5,8,8	16		4.5+	
SS	2	3,4,6	10			
SS	3	3,7,5	12			
SS	4	2,2,4	6			
SS	5	1,3,7	10			
SS	6	11,8,11	19			



Drill Method: Hollow Stem Augers

Drill Date: March 22, 2010

Hole Size: 150 millimetres

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Datum: Geodetic

Checked by: JM

Sheet: 1 of 2

Project No: SM 072893-G

Project: Storm Sewer Outfall Relocation

Client: Phillips Engineering Ltd.

Location: Plains Road West, Burlington

Log of Borehole No. 101

Borehole Location: See Drawing No. 1

Project Manager: John Monkman, P.Eng.

Soil-Mat

SUBSURFACE PROFILE

Depth	Elevation [m]	Symbol	Description	Well Data
	85.92			
			Silty Clay Grey, very stiff	
	84.72			
			End of Borehole	

NOTES:

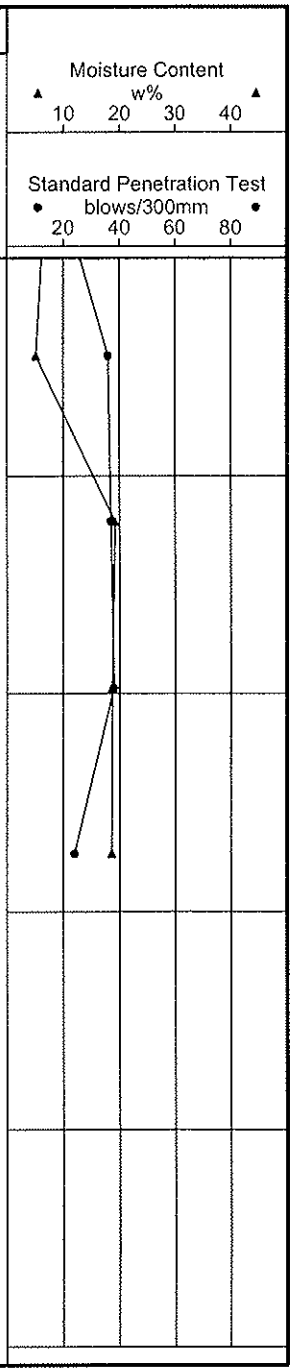
1. Borehole was advanced using hollow stem auger equipment on March 22, 2010 to termination at a depth of 15.7 metres.

2. Borehole 'dry' on completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2), Qu	U.Wt.(kN/m3)
SS	7	9,17,19	36			
SS	8	9,14,23	37			
SS	9	11,16,22	38			
SS	10	5,10,14	24		4.5+	



Drill Method: Hollow Stem Augers

Drill Date: March 22, 2010

Hole Size: 150 millimetres

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Sheet: 2 of 2

Project No: SM 072893-G

Project: Storm Sewer Outfall Relocation

Client: Phillips Engineering Ltd.

Location: Plains Road West, Burlington

Log of Borehole No. 102

Borehole Location: See Drawing No. 1

Project Manager: John Monkman, P.Eng.

Soil-Mat

SUBSURFACE PROFILE

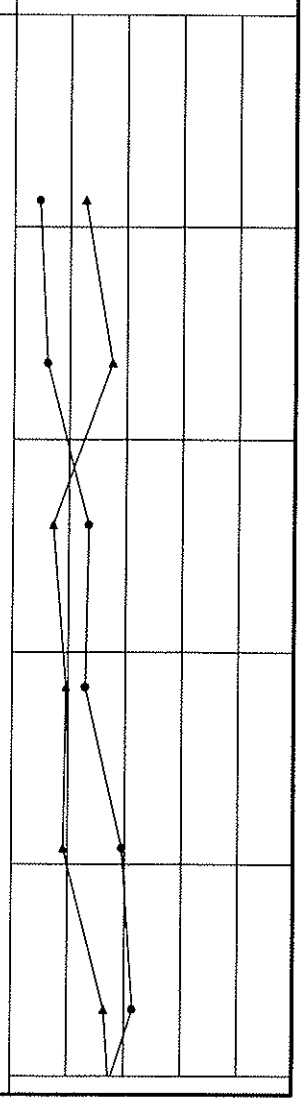
Depth (ft)	Depth (m)	Elevation [m]	Description
0	0	96.17	Ground Surface
			Topsoil Approximately 150 millimetres over,
			Sand Brown, occasional clayey silt seams, trace of fine gravel, loose
		93.17	
			Clayey Silt Reddish brown trace of fine gravel and sand, stiff
		92.17	
			Sand Brown, 'fine' grained, trace to some fine gravel and silt, occasional brown silty fine sand and clayey silt seams, higher gravel content and 'wet' at transition to silty clay, compact to dense

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2), Qu	U.Wt.(kN/m3)
SS	1	4,4,5	9			
SS	2	4,6,6	12			
SS	3	8,12,15	27			
SS	4	8,11,15	26			
SS	5	18,18,21	39			
SS	6	18,21,22	43			

Moisture Content w% (10, 20, 30, 40)

Standard Penetration Test blows/300mm (20, 40, 60, 80)



Drill Method: Hollow Stem Augers

Drill Date: March 22, 2010

Hole Size: 150 millimetres

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Sheet: 1 of 2

Project No: SM 072893-G

Project: Storm Sewer Outfall Relocation

Client: Phillips Engineering Ltd.

Location: Plains Road West, Burlington

Log of Borehole No. 102

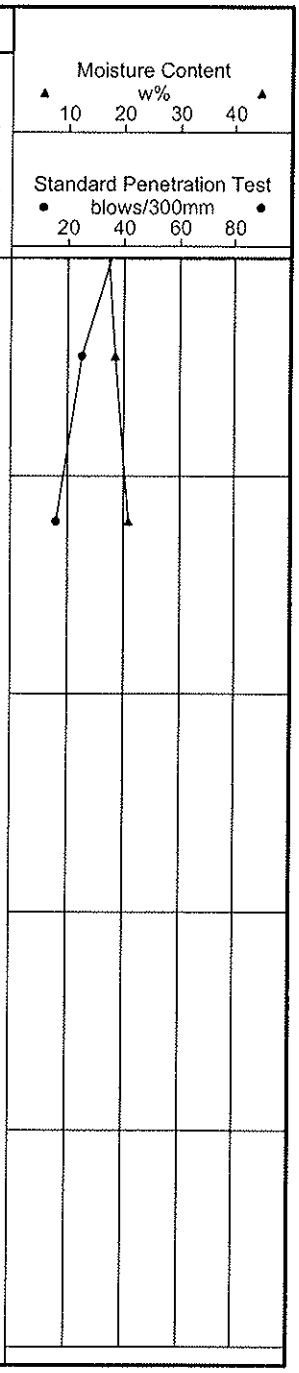
Borehole Location: See Drawing No. 1

Project Manager: John Monkman, P.Eng.

Soil-Mat

SUBSURFACE PROFILE / SAMPLE

Depth	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2), Qu	U.Wt.(kN/m3)
	85.92										
34			***Silty Clay*** Grey, occasional clayey silt seams, very stiff								
36					SS	7	9,10,15	25		4.5+	
38											
40 (12)	83.52				SS	8	6,7,9	16		4.5	
42			End of Borehole								
44											
46 (14)											
48											
50											
52 (16)											
54											
56											
58 (18)											
60											
62											
64											



NOTES:

1. Borehole was advanced using hollow stem auger equipment on March 24, 2010 to termination at a depth of 12.65 metres.

2. Borehole 'dry' on completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Hollow Stem Augers

Drill Date: March 22, 2010

Hole Size: 150 millimetres

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Sheet: 2 of 2

Project No: SM 072893-G

Project: Storm Sewer Outfall Relocation

Client: Phillips Engineering Ltd.

Location: Plains Road West, Burlington

Log of Borehole No. 103

Borehole Location: See Drawing No. 1

Project Manager: John Monkman, P.Eng.

Soil-Mat

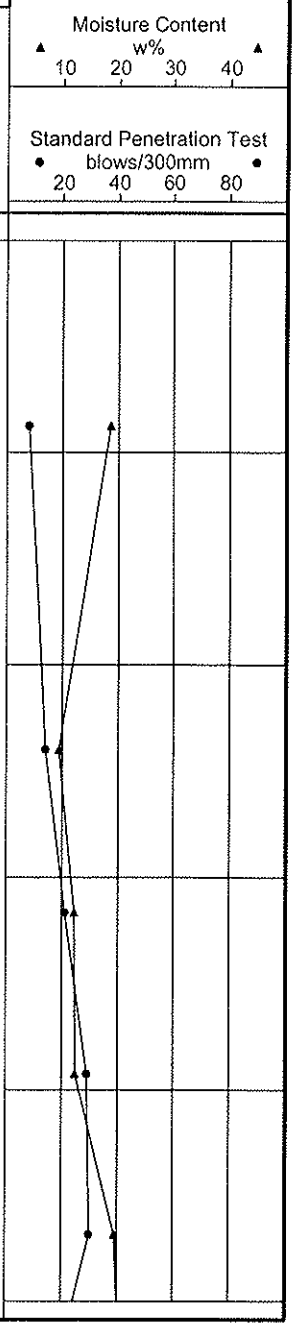
SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Elevation [m]	Description
0	0	94.69	Ground Surface
			Topsoil Approximately 150 millimetres over,
			Clayey Silt Fill Brown, some organic staining, some sand and fine gravel, occasional cobbles, trace of roots/wood, compact
		90.69	
			Sand Brown, 'fine' grained, trace to some fine gravel, trace of silt, higher gravel content and 'wet' at transition to silty clay, compact
		86.19	
			Silty Clay Grey, trace of shale fragments upper level, hard to very stiff
		84.69	

Well Data

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2), Qu	U.Wt.(kN/m3)
SS	1	1,3,5	8			
SS	2	2,3,4	7			
SS	3	6,6,8	14			
SS	4	7,9,12	21			
SS	5	11,13,16	29			
SS	6	10,13,17	30		4.5+	



Drill Method: Hollow Stem Augers

Drill Date: March 22, 2010

Hole Size: 150 millimetres

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Sheet: 1 of 2

Project No: SM 072893-G

Project: Storm Sewer Outfall Relocation

Client: Phillips Engineering Ltd.

Location: Plains Road West, Burlington

Log of Borehole No. 103

Borehole Location: See Drawing No. 1

Project Manager: John Monkman, P.Eng.

Soil-Mat

SUBSURFACE PROFILE					SAMPLE						
Depth	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2), Qu	U.Wt.(kN/m3)
34			***Silty Clay*** Grey, trace of shale fragments, hard to very stiff								
36	83.59				SS	7	4,7,9	16		3.5	
			End of Borehole								
38											
40 (12)											
42											
44											
46 (14)											
48											
50											
52 (16)											
54											
56											
58 (18)											
60											
62											
64											

Moisture Content w% ▲ 10 20 30 40 ▲

Standard Penetration Test blows/300mm • 20 40 60 80 •

NOTES:

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Drill Method: Hollow Stem Augers

Drill Date: March 22, 2010

Hole Size: 150 millimetres

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